HOW TEST RESULTS UNDER DEP'S SURFACE WATERS TOXICS CONTROL PROGRAM ARE EVALUATED

The toxicity results from any effluent must be compared to acceptable -in-stream concentrations in order to determine if adverse effects may result from that particular discharge. For WET tests, the limits reflect a direct dilution of the effluent in the receiving water on a percentage basis. For priority pollutants, the allowable in-stream concentrations are contained in Water Quality Criteria published by EPA, which Maine has adopted. Those criteria have separate standards designed to protect both aquatic organisms and human health. The aquatic standards are set to prevent short-term (acute) and long-term (chronic) adverse effects on organisms in the receiving water. The human health standards have concentrations intended to avoid health problems due to either (1) eating organisms taken from that body of water or (2) drinking water and eating organisms from a body of water. Each pollutant has its own set of standards. In general, the metals have lower standards for aquatic organisms, while organic compounds have lower limits for the two human health criteria.

A primary consideration in toxicity evaluation is a treatment facility's dilution factors. These values reflect the mixing of an effluent at a given concentration with the receiving water under low flow conditions. In fresh waters, dilution factors are based on 7Q10 and 1Q10 low flows for chronic and acute calculations, respectively. In priority pollutant evaluations, ¼ of the 7Q10 flow is used in some locations where there is not good mixing with an approved outfall structure. For considering human health effects of priority pollutants, a longer term exposure based on the harmonic mean flow is used. The harmonic mean is an estimate of the flow in a river over a longer averaging period, and is typically three times the 7Q10 flow. In marine waters, an EPA model is used to determine near-field dilution factors. In all situations, both acute and chronic dilution factors are used for WET tests in conjunction with the respective test procedure.

The rule specifies how effluent tests are to be evaluated using two separate criteria. The first is a comparison of the in-stream concentrations after including dilution of the effluent to see if there is a direct exceedence of the applicable water quality criteria. This is done on an individual test-by-test basis and the resulting answer is a simple yes or no. Essentially, the effluent concentration is divided by the applicable dilution factor to give a concentration in the receiving water. This value is next compared to the applicable water quality criteria. If the receiving water concentration from the diluted effluent is greater than the criteria, an exceedence condition exists.

The second evaluation is more complicated and involves a statistical analysis of the tests that have been done to see if there is a reasonable potential for a water quality criteria exceedence to occur under all conditions. This approach is based on the assumption that given a small number of samples, it is unlikely that the greatest, or least result possible, will occur in a particular sample. Bear in mind that the toxicity testing program involves only a very small percentage of the total discharge days over the period of a year or in some cases several years. With such a limited sampling program, the odds are small that the most toxic test result possible will actually be recorded. You can compare this to the odds of drawing a particular card from a deck of hundreds on the first try.

The reasonable potential calculation used by DEP to evaluate toxicity is the method from EPA's "Technical Support Document for Water Quality-Based Toxics Control". It considers the single most toxic test result recorded, the number of tests done, and the facility's dilution factors. The chances of reasonable potential for toxicity in the receiving water are influenced by each of these criteria in the following ways:

- The more toxic the actual test result is, the greater the risk for reasonable potential.
- A higher number of tests will reduce the risk of reasonable potential since the calculation is more reliable with a larger sample size.
- Low dilution factors make reasonable potential more likely.

As an example, at a given dilution factor and with similar tests results, simply doing an additional test can allow a facility to test out of reasonable potential because the sample size is increased, thereby reducing uncertainity associated with the smaller sample size. Conversely, a facility can be placed in reasonable potential if an additional test is more toxic than previous ones.

The reasonable potential method applies a correction factor based on the number of tests which have been done. The greater number of tests, the lower the correction factor, reflecting the greater statistical confidence coming from a larger number of samples. The method also includes a coefficient of variation which gives consideration to the distribution of individual tests results. However, if there are less than 10 samples, an assumed coefficient of variation of 0.6 is used. Where the cofficient of variation is 0.6, the correction factors to be used are:

Number of Samples	Correction Factor	Number of Samples	Correction Factor
1	6.2	6	2.1
2	3.8	7	2.0
3	3.0	8	1.9
4	2.6	9	1.8
5	2.3	10	1.7

Determinations for water quality exceedences and reasonable potential are done separately for both acute and chronic WET tests with individual species and for each specific chemical in the priority pollutant test series. The analysis of WET test uses the lowest percentage (i.e. the dilution toxic at 25%, 50%, etc.) reported, since this represents the highest level of toxicity. For the purposes of compliance under the current rule, DEP does calculations only with No Observed Effect Level (NOEL) test results. To the extent possible, LC50 test results on file were given credit toward future requirements at the time the rule became effective. The priority pollutant evaluation relies on the highest concentration found for each compound. In many cases, compounds have been reported as less than certain concentrations at the laboratory detection level, and these values are counted in the total number tests done, but are not included in numerical calculations. If all the tests done for a specific compound are reported as "less than" (<) values, it is assumed there is no reasonable potential or water quality exceedence in those

cases.

Example Calculations

A facility has done 4 WET tests series and 2 series of priority pollutant tests. The acute dilution factor is 23:1 and the chronic dilution factor is 35:1. The harmonic mean flow dilution factor used to evaluate human health criteria is 110:1.

Evaluation of WET test results

Results were: Acute: 100%, 50%, 50% and 25%; Chronic: 75%, 25%, 6.25% and 25%

In WET testsing the lowest values represent the most toxic conditions, so those values are used in the calculations. Since 4 tests were done, the correction factor from the EPA manual is 2.6.

1. Determine the critical receiving water concentrations as percentages by dividing the dilution factors into 100%:

Critical receiving water concentration = 100% / dilution factor

Acute critical value = 100% / 23 = 4.35% Chronic critical value = 100% / 35 = 2.86%

To avoid in-stream toxic effects, the acute and chronic test results must be above 4.35 and 2.86.

2. Evaluate for water quality criteria exceedence.

Since the lowest acute test result of 25% is greater than the critical value of 4.35%, there is no exceedence of acute receiving water concentrations for this effluent.

Since the lowest chronic test result of 6.25% is greater than the critical value of 2.86%, there is no exceedence of chronic receiving water concentrations for this effluent.

3. Evaluate acute tests for reasonable potential.

Acute Reasonable Potential = minimum test / correction factor = 25% / 2.6 = 9.6%

Since the calculated value of 9.6% is greater than the critical value of 4.35%, there is no reasonable potential for acute effects with this effluent.

4. Evaluate chronic tests for reasonable potential.

Chronic Reasonable Potential = minimum test / correction factor = 6.25% / 2.6 = 2.4%

Since the calculated value of 2.4% is less than the critical value of 2.86%, there is reasonable potential for chronic effects with this effluent.

Evaluation of priority pollutant tests

Results were: Copper 25 ug/L and 17 ug/L Pentachlorophenol 40 ug/L and <3.6 ug/L

In priority pollutant testing, the highest value represents the most toxic condition, so that value is used in calculations. Since 2 tests were done, the correction factor from the EPA manual is 3.8.

1. Determine the allowable in-stream water quality criteria from EPA's Water Quality Criteria:

copper	acute = 3.89 ug/L	Pentachlorophenol	water and organisms = 0.282 ug/L
copper	chronic = 2.99 ug/L	Pentachlorophenol	organisms only = 8.16 ug/L

Note: the copper values are protective of aquatic life while the pentachlorophenol standards are human health criteria. In each case the respective values are the most critical requirements.

2. Evaluate for direct water quality criteria exceedence. The receiving water concentration in ug/L is determined by dividing the effluent concentration by the appropriate dilution factor. If this value is greater than the allowable criteria, there is an exceedence.

Receiving water concentration (RWC) = maximum concentration / dilution factor

Pollutant	Max. Conc.	Dilution	RWC	Criteria	Exceedence?
Copper, Acute	25 ug/L	23	1.08 ug/L	3.89 ug/L	No
Copper, Chronic	25 ug/L	35	0.71 ug/L	2.99 ug/L	No
Pentachlorophenol, Water+Organi	40 ug/L	110	0.36 ug/L	0.28 ug/L	Yes
Pentachlorophenol, Organisms	40 ug/L	110	0.36 ug/L	8.16 ug/L	No

There is an exceedence of receiving water criteria for pentachlorophenol, water and organisms.

For other compounds and criteria, there are no exceedences.

3. Evaluate copper for reasonable potential. Separate evaluations are done for acute and chronic.

Reasonable potential concentration = (maximum test X correction factor) / dilution factor

Acute concentration = (25 ug/L X 3.8) / 23 = <u>4.13 ug/L</u>

Chronic concentration = (25 ug/L X 3.8) / 35 = <u>2.71 ug/L</u>

The acute concentration is greater than the criteria of 3.89 ug/L, so there is reasonable potential for acute toxic effects with this effluent.

The chronic concentration is less than the criteria of 2.99 ug/L, so there is no reasonable potential for chronic toxic effects with this effluent.

4. Evaluate pentachlorophenol for reasonable potential. Separate evaluations are done for water and organisms criteria and organisms only criteria.

Reasonable potential concentration = (maximum test X correction factor) / dilution factor

Concentration = (40 ug/L X 3.8) / 110 = 1.38 ug/L

The concentration is less than the criteria of 8.16 ug/L for organisms only, so there is no reasonable potential for that criteria.

The concentration is greater than the criteria of 0.282 ug/L for water and organisms, so there is reasonable potential for that criteria.

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